A
SYLLABUS,
OF
CHEMICAL AND PHILOSOPHICAL ENQUIRIES,

Compoſed for the Uſe

OF THE

NOBLEMEN and GENTLEMEN

Who have ſubſcribed to the PROPOSALS made, for the Advancement of

NATURAL KNOWLEDGE,

By B. HIGGINS, M.D.

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ADVERTISEMENT.

THE following Propoſals, altho' formerly publiſhed, are inſerted with a view to expreſs the purpoſes for which the approaching meetings are to be held.

DOCTOR HIGGINS of *Greek Street*, *Soho*, encouraged by the Literary NOBLEMEN and GENTLEMEN, who have ſubſcribed to his Courſes of philoſophic and practical Chemiſtry, addreſſes the following Propoſals to the patrons of Natural Philoſophy and uſeful Arts.

PROP. I.

That fifty philoſophic and literary Gentlemen do concur in promoting experimental enquiries into the Elements of Matter and Laws of Nature, and ſuch other ſubjects as are moſt important in Natural Philoſophy, Chemiſtry and Arts:

II.

That until better meaſures can be deviſed and agreed on, the Plan, offered in theſe Propoſals, be adopted:

III.

That, as the Elaboratory of DOCTOR HIGGINS is already provided with a conſiderable apparatus, and ſeveral neceſſary accommodations for the abovementioned purpoſes; and as he hath manifeſted a diſpoſition and attention which recommend him on this occaſion, his Elaboratory ſhall be the place wherein theſe enquiries ſhall be made, and he ſhall conduct the experiments:

IV.

That a Subſcription be immediately opened by DOCTOR HIGGINS for the purpoſes expreſſed in the foregoing and the ſubſequent Propoſals: That each Subſcriber do contribute ten guineas: That the Gentlemen who are deſirous to ſubſcribe do give the earlieſt notice thereof to DOCTOR HIGGINS; and that the Subſcription be cloſed when fifty Gentlemen ſhall have ſubſcribed:

V.

That the firſt general meeting of the Subſcribers be on *Monday* the 13th of *November* 1775, at ſeven o'clock in the afternoon, in the Elaboratory abovementioned; and that they be, every other day, for three months thereafter, at an hour to be appointed by the Subſcribers at the firſt meeting:

VI.

That previous to theſe meetings, DOCTOR HIGGINS do appropriate an hour every day, from ten to eleven o'clock in the forenoon, to hear the ſentiments and receive the inſtructions of the Subſcribers—the month of *July* only excepted:

That

VII.

That Doctor Higgins ſhall preciſely at the hours to be appointed, open each of theſe meetings with a Diſcourſe in the Didactic Form: That in theſe Diſcourſes he ſhall introduce the Natural Phenomena, the illuſtrative obſervations and experiments of Philoſophers, Chemiſts and Artiſts; and particularly his notions and experiments concerning the Primary Elements and the Properties of Matter.

That by bringing into one view what hath been hitherto diſcovered, together with a conſiderable number of ſuch new and concluſive experiments on theſe ſubjects, as he hath deviſed, and as ſhall be maturely deviſed by the Subſcribers, he ſhall endeavour to improve the former, or eſtabliſh better, doctrines:

VIII.

That every thing to be advanced by him on theſe occaſions, ſhall be ſupported by obſervations and experiments to be made in a conſpicuous manner before the Subſcribers, or by producing the apparatus and reſult of ſuch experiments as require much time, and muſt neceſſarily be made during the intervals of the meetings:

That

IX.

That each Introductory Diſcourſe ſhall not exceed half an hour, unleſs protracted by very intereſting experiments; and that afterwards the time be employed by the Subſcribers in communicating, objecting, propoſing or deviſing whatever may be thought conducive to the purpoſes already expreſſed:

X.

That the Subſcribers be at all times admitted to ſee and direct the operations and experiments:

XI.

That minutes be taken of the proceedings, recording all that ſhall be meritoriouſly ſuggeſted or done by each Subſcriber; and that theſe minutes be the property of the Subſcribers:

XII.

That aſſiſted and adviſed by the learned Gentlemen who have already ſubſcribed, and thoſe who will pleaſe to ſubſcribe in due time, DOCTOR HIGGINS ſhall exert himſelf during the Summer and Autumn previous to the propoſed meetings, in preparing and arranging the matter of the intended Introductory Diſcourſes; in forming a Syllabus for the uſe of the Subſcribers; in deviſing inſtruments and experiments, and making an addition to his preſent apparatus, ſuitable to the occaſion and the abovementioned liberal ſubſcription:

FINALLY.

That DOCTOR HIGGINS ſhall be accountable for the ſubſcribed ſums, in caſe he ſhould be prevented, by ſickneſs, or otherwiſe, from performing his part in this undertaking.

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As a conſiderable number of Gentlemen have lately ſubſcribed, who, though eminent in other departments of ſcience, think themſelves not ſufficiently acquainted with Chemiſtry; Doctor Higgins, in order to enable each ſubſcriber more effectually to promote the views of theſe meetings, will give a *Previous Courſe* of Practical Chemiſtry, in which the didactic order will be preſerved. In this preparatory courſe, many intereſting experiments, will be introduced in a manner ſubſervient to the reſearches alluded to in the following Syllabus.

A

SYLLABUS

OF THE

DISCOURSES AND EXPERIMENTS,

With which the Meetings of the Subſcribers
are to be opened, after the Courſe of
Chemiſtry is concluded.

INTRODUCTORY diſcourſe on matter in general, called groſs matter; on the varieties and diſtinctions of groſs matter; on the primary elements of matter.

Obſervations on the experiments and phenomena exhibited in the foregoing courſe of chemiſtry, and other experiments which demonſtrate the exiſtence of ſeven primary diſtinct elements of matter, *viz.*

Earth,	Air,
Water,	Phlogiſton,
Alkali,	Light,
Acid,	

Experiments, obſervations, and arguments, ſhewing upon what grounds, fire, the etherial fluid of modern philoſophers, and the mercurial principle of the chemiſts, are to be rejected from the claſs of primary elements.

Experiments, obſervations, and arguments, perſuading that each primary element conſiſts of atoms homogeneal; that theſe atoms are impenetrable, immutable in figure, inconvertible, and that in the ordinary courſe of nature they are not annihilated, nor newly created.

Obſervations and experiments, perſuading, that the atoms of each element are globular, or nearly ſo; and that the ſpiral, ſpicular, and other figures aſcribed to theſe atoms, are fictions unneceſſary, and are inconſiſtent with the uniformity and ſimplicity of nature, and repugnant to experience.

Practical applications of theſe doctrines; diagrams conſtructed in conſequence thereof, and obſervations on the uſes and importance of diagrams in the enſuing reſearches.

Obſervations illuſtrated by experiments of our ſenſe of the foregoing ſeven elements, ſeparately; of our ſenſe of the union of two or more of the foregoing elements. Experiments and obſervations, ſhewing, that the poſſible and known unions of the foregoing elements; and that the poſſible and known proportions, in which the unions, of the foregoing elements may take place, are more numerous than the bodies diſtinguiſhed by philoſophers or naturaliſts; perſuading, that all known bodies are really compoſed of one or more of the foregoing elements; and that all bodies muſt be admitted to conſiſt of theſe only, until other elementary matter is found neceſſary for the explication of the natural phænomena, and is demonſtrated to exiſt.

A claſſical arrangement on the table of bodies, compoſed of two or three primary elements; which bodies, in various chemical proceſſes, not being decompoſed, we call chemical elements, or the elements of the chemiſts.

A like claſſical arrangement of bodies compoſed of two chemical elements.

A like claſſical arrangement of bodies and natural ſubſtances compoſed of many chemical elements.

Remarks on the foregoing bodies, with a view to inculcate ſuch general knowledge of them as will facilitate the future inveſtigation of the elements and properties of matter, &c.

Examination of the doctrines of authors, who admit various kinds of attraction, as ſo many diſtinct laws of nature; of others who aſcribe attraction and repulſion to the agency of an ethereal repellent fluid; and of others who attribute the attraction of bodies to the operation of an intermediate matter or cementing principle.

Review of experiments made in the preceding courſe of practical chemiſtry, and obſervations authorizing the propoſal of the following opinions and the phrazes briefly expreſſing them, with a view to facilitate the enſuing inveſtigations.

Opinion,

1. That the homogeneal atoms of five elements repell reciprocally.

2. That the homogeneal atoms of two elements attract reciprocally.

3. That the diſſimilar atoms of five elements attract repricocally.

4. That the diſſimilar atoms of two elements repel reciprocally.

5. That the attraction ſubſiſting between elementary atoms, is more forcible in one direction or axis of each atom, than in any other direction; and that there is a polarity in all matter whatever.

6. That there is but one ſpecies of attraction operating with great force between the ſimilar or diſſimilar atoms of certain elements; and with leſs force between thoſe of other elements, in gradations, but in all affected by diſtance and polarity.

7. That the attractions of bodies enumerated as diſtinct properties of matter or laws of nature, are nothing more than the ſums of the attractions of their elementary atoms; or theſe forces counteracted in a certain degree by the preſence of repellent atoms, or theſe forces exerted to the greateſt advantage in bodies whoſe primary elementary attractions are ſtrongeſt, and whoſe primary elementary atoms, are alſo arranged in polar order.

8. That ſpecific gravity is not as the quantity of matter in a given ſpace, but as

the quality of the matter, or the ſum of its elementary attractions. Conſequently that light bodies are not neceſſarily more porous than the heavieſt.

Obſervations on the phenomena preſented in the practical courſe of chemiſtry, and authorizing the following poſitions concerning fire: viz.

1. That fire pervades all known bodies.

2. That fire expands all known bodies.

3. That fire produces effects on bodies diametrically oppoſed to the power and effects of attraction.—That it counteracts and in effect, weakens, balances, or overpowers the force of attraction.

4. That poſitions concerning the univerſal effects of fire, but extending no further, and equally conſiſtent with nature and the doctrines of philoſophers, may be inſerted in any part of a ſyſtem of natural philoſophy, antecedent to the inveſtigation of the cauſe of theſe effects.

Of the Earthy Element, and Bodies conſiſting of this Matter chiefly.

The metalizable earths, the unmetallic earths, and compound earthy bodies arranged on the table.

Obſervations and experiments, ſhewing that near ſix hundred diſtinctions of earthy bodies, made by naturaliſts, altho' uſeful in arts, are to be rejected in chemical philoſophy, inaſmuch as theſe varieties are produced in many by the mode of aggregation only, and in others by heterogeneous admixture, or combination.

Obſervations and experiments, ſhewing the grounds on which we ought for a while, to admit the following diſtinctions of earths, *viz.*

Seven earths, capable of forming ductile metals.

Seven earths, capable of forming metals not ductile,

Seven earths, incapable of forming metal.

Queſtion 1. Is there but one earthy element, which in various modes of aggregation, or in indiſſoluble combination with other elementary matter, forms twenty-one earthy bodies; or, *Queſt.* 2. Are there three times ſeven, or ſeven times ſeven, earthy elements.

The affirmative of the firſt queſtion urged by experiments, obſervations and arguments.

The negative of the firſt queſtion urged by obſervations and arguments.

Probable concluſions.

New experiments with a view to decide on the foregoing queſtions.

Propoſitions concerning the method to be obſerved in the enſuing inquiries; and arguments perſuading that if we confine ourſelves to the conſideration of properties common to all earthy bodies, our future reaſoning will not be erroneous, whether there be, only one, or many earthy elements.

Illuſtrative diagrams, exhibiting the circumſtances in which we may, without inconvenience, uſe the word earthy element, for the future; and the circumſtances in which we may occaſionally attend to the chemical claſſes of earthy bodies, yet avoid contradiction or error.

Experiments and obſervations ſhewing that the earthy elementary atoms, attract the atoms of other elements; and arguments perſuading that theſe attractions are not to be further conſidered in this place, but reſerved until the other elements come under examination.

Experiments and obſervations, ſhewing that the homogeneous atoms of earth, attract each other.

Experimental and geometrical eſtimation, of the force of this attraction in fortuitous arrangement of the atoms, and of the force of this attraction in the polar arrangement of the atoms.

Experimental and geometrical eſtimation of this attraction in contact, compared with its force at given diſtances.

Review of the phenomena exhibited in the practical courſe of chemiſtry, which authorize the anticipation of doctrines hereafter demonſtrated, *viz.* The doctrine of the repulſion of the homogeneal atoms of all elements except earth and water; of the forcible attraction of earthy atoms to each other; of the force with which they attract other elements; of the quantity of earthy matter, and the ſums of the attractions of earth to earth and other matter. Inductions that earth ought to gravitate more than any other known matter, and as it doth gravitate agreeable to the premiſes, that the gravitation of earth is not a diſtinct law of nature, but the ſum of the forces of the elementary attraction of earth to earth and other matter.

The attraction cauſing aggregation and gravitation of earth conſidered in oppoſition to the action of fire. General obſervations on fixity, expanſibility, fuſibility, fluidity, volatility, evaporation; the fixity of earths, rationally, and experimentally deduced from the foregoing properties of this element; fixity being an effect of attraction, and not admiſſible as a law of nature.

The other properties of this element, and the concluſions further deducible from theſe already recited, are to be ſubjects of future conſideration.

Of the Element of water.

Of diſtilled rain, river, ſpring, and mineral waters, and their impregnations.

The experiments of Boyle, Borrickius, Wallerius, Leidenfroſt, Margraaff, Eller, and Lavoiſier, conſidered, and the concluſive experiments repeated; together with new experiments, proving water to be an elementary matter incapable of decompoſition; that the pretended converſion of water to earth is an erroneous notion, and that there is but one aqueous element.

Obſervations and experiments, perſuading that the pureſt known ſtate of the watery element, is that of ice, and that ice becomes fluid by the interpoſition of fire, or aerial, or acid, or other matters, demonſtrable one or more in all fluid water, and expelled or drawn away in freezing.

Various phenomina of freezing natural and artificial, exhibited and explained.

Obſervations and experiments, ſhewing, that the indeſtructible immutable atoms of water do attract each other: ſhewing further the ratio of this attraction in contact of the atoms, and at given diſtances;

And ſhewing that this attraction is leſs forcible than the atomary attraction of homogeneous earthy atoms;

And that the atoms of water have polarity.

Obſervations and experiments, proving that water and earth reciprocally attract each other.

Obſervations on capillary attraction, Intr、oſuſception, wetting, &c.

Eſtimation of the attractions ſubſiſting between the atoms of water, and between water and earth and other matter, and of the relative quantities of theſe matters.

Inductions that the gravitation of water correſponds with the ſum of the elementary attractions, and that gravitation is not, in water, a primary law of nature.

Experiments, ſhewing that bodies of the greateſt ſpecific gravity, (as gold, &c.) when finely divided will float on water, or remain ſuſpended in it wherever they are placed.

Inductions from the premiſes explaining theſe phenomena, and many others, particularly the phenomena of bubbles, drops and ſtreams of water, of the formation, of ſpars, ores, &c. And ſhewing why many bodies are formed in water and works effected in the lapſe of time, which no art can extemporaneouſly accompliſh.

Reaſons why the phenomena of water, with inflammable and other bodies, are not yet to be introduced.

Experiments, demonſtrating the effects of fire on water in all the varieties induced by preſſure, whether by the altitude of the column, or by air, vapour, &c. and experiments, &c. relative to the balneum mariæ, balneum vaporis, Papin's digeſtor, water ſuſtaining red heat, evaporation, diſtillation, condenſation, ebulition in air, and in vacuo, exploſions of water; and the circumſtances in which this element is palpable or only viſible, or totally inviſible.

Explanations of theſe phenomena, according to the premiſed properties of water and the known effects of fire.

Of the Alkaline element.

Chemical hiſtory of alkaline ſubſtances, in the order in which they ſtand on the table.

Experiments, ſhewing the inſufficiency of the vulgar teſts of alkaline ſubſtances; that alkali doth exiſt in all bodies from which it is by any means obtainable; that it is not the *creature of fire*, as the chemiſts imagine;

that it is only extricated by fire, as other matters are from compound bodies. Inductions, that fire ſevers bodies, but neither creates nor deſtroys matter.

Obſervations and experiments, ſhewing that all the alkaline ſubſtances of the chemiſts, are compound bodies. And that the cauſtic volatile alkali is that which is leaſt compounded.

Experiments, ſhewing the alkaline matter ſolitary, and demonſtrating this to be an elementary matter, altho' not hitherto known or noticed as ſuch, and that there is but one elementary alkali.

Obſervations and experiments, ſhewing that the atoms of alkaline element repel each other; and ſhewing the ratio of this repulſion at given diſtances, and that by reaſon of this repulſion varied by diſtance, this element is an elaſtic, compreſſible, expanſible, inviſible fluid.

Experiments ſhewing the atomary repulſion of this element, counterpoiſed by the attraction of other matter, and the formation of fluids of greater denſity or leſs volume, but yet inviſible: And next, the atomary repulſion of alkaline element overpowered by the attraction of other matter to its atoms, which are thus approximated ſufficiently to form a palpable fluid: And laſtly, the atomary repulſion of alkaline element ſo much overpowered by the attraction of other interpoſed matter, that ſolid ponderous maſſes are formed therewith.

The cementing principle, alkaline air, and other conceits of the like nature, conſidered.

The true cauſes of ebullition, intumeſcence, efferveſcence, and of the incoercible vapours of the chemiſts, conſidered; and practical advantages reſulting from this knowledge, experimentally demonſtrated.

Experiments and calculations aſcertaining the diſtance to which the repulſion between the atoms of alkali can be extended, with a force equal to the whole preſſure of the atmoſphere: The force of this repulſion alſo conſidered at ſmaller and greater diſtances.

Probable ſuggeſtions that repulſion and attraction, which are forcible in contact, leſs forcible but yet menſurable at various diſtances, do univerſally extend to diſtances indefinite, altho' not perceptible to our imperfect organs of ſenſe.

Inductions, explaining the conditions in which matter is inviſible, viſible, fluid, ſolid, compreſſible like air, or incompreſſible; and experiments ſhewing, that alkali, like other matter, reduced to a ſtate in which it eludes vulgar obſervation, and in which it hath been ſuppoſed to be loſt or commuted, is nevertheleſs identical, incommutable, indeſtructible.

That attraction and repulſion being indefeaſible properties of alkaline and other matter, ſuffer no ſuſpenſions, fits, or interterruptions, and never are commuted in any circumſtance or diſtance, but only balance or overpower one the other, and thus occaſionally ſeem to be weakened or deſtroyed.

General obſervations on the elaſticity of fluids and of ſolid bodies.

Experiments ſhewing, that repulſion is the cauſe of the former elaſticity and attrac- the cauſe of the latter.

Inductions concerning fluidity, ſoftneſs, hardneſs, plaſticity, ductility, brittleneſs, applied to earth, water, alkali, and compounds of them, and equally applicable to other elements and compounds.

Experiments to determine whether the alkaline element conveys ſound, which it is preſumed it will do.

Obſervations and experiments ſhewing the polarity of the alkaline element, and the difference of the aggregations formed by fortuitous arrangement, from thoſe formed by polar arrangement of this elementary matter in combination.

Saturation conſidered in the manner of the ſchools.

The true cauſe of ſaturation inveſtigated.

Experiments, ſhewing that no element doth ſaturate, nor can ſaturate the like element; that no element, whoſe atoms attract each other, can ſaturate any other element whoſe atoms attract each other; that a repellent element doth ſaturate non-repellent elements, and *vice verſa*; that repellent elements do ſaturate reciprocally; and that attraction and repulſion, operating adverſely are the cauſe of ſaturation; and ſaturation is not a diſtinct or primary law of nature, but an effect.

Experiments and diagrams, explaining the phenomena of inviſible fluids formed by two or more elements which attract and ſaturate each other; the phenomena of viſible or aqueous fluids formed by two or more elements which attract and ſaturate each other; and the phenomena of ſolid maſſes formed by two or more elements which attract and ſaturate each other; demonſtrating the cauſes of theſe phenomena, and of all the conditions of ſaturated elaſtic fluids, ſaturated incompreſſible fluids, and ſaturated ſolid bodies, and the other conditions of ſaturated matter intermediate between theſe.

Experiments, ſhewing the various new appearances and properties different from thoſe of the pure elements, induced by ſaturation; and experiments and diagrams, demonſtrating that ſaturation muſt neceſſarily induce ſuch new appearances and properties, without the aſſiſtance of any laws of nature except thoſe of attraction and repulſion; and conſequently that all the viſible varieties of compound bodies, and their diſtinguiſhing properties, the *tertium quid* of the chemiſts, &c. &c. depend on the properties attributed above to the ſeven primary elements.

Experiments, ſhewing that elementary alkali attracts earth.

Eſtimations experimental of the force of this attraction in contact, and at given diſtances, in fortuitous, and in polar arrangement of the atoms.

Experiments, ſhewing that alkaline element attracts water.

Experimental eſtimations of the force of this attraction in contact, and at given diſtances.

Experiments, ſhewing the levity or weak ſpecific gravitation of the alkaline element; the ſum of its attractions compared with thoſe of earth and water; the ſum of its repulſions conſidered. The force with which it ought to gravitate, according to the premiſes, eſtimated; and being found to correſpond with the real gravitation of this element; the gravitation of alkali is to be held as the exceſs of the foregoing attractions above the ſum of the repulſions, and not as a primary law of nature.

Reaſons why the action of fire on alkali, and various phenomena of alkali in combination, are reſerved for future conſideration.

Of Acids in general.

The chemical hiſtory and diſtinctions of acids, in the order in which they ſtand on the table.

Obſervations and experiments ſhewing, that all the acids of the chemiſts are compound bodies.

The queſtion concerning the identity of the acid element ſtated.

Obſervations, experiments and arguments *Pro.*

Obſervations, experiments and arguments *Contra.*

The arguments *pro* and *contra* weighed; new experiments, and all experiments propoſed in the minute-book, to be made with a view to decide the foregoing queſtion.

Probable concluſions, that the acid element exiſts in the vitriolic and marine acids in a ſtate neareſt to purity; and that from theſe, together with the nitrous and acetous acid, the characters of acids are to be drawn.

A method propoſed, and to be obſerved on the part of the author, whereby the future inveſtigations ſhall not be interrupted, and the future doctrines ſhall not be erroneous, whether there be one or many acid elements; which method is the ſame as is obſerved with reſpect to earth. See Earth.

Experiments ſhewing, that acid matter is not commuted or deſtroyed, in any combuſtions or detonations, or other proceſſes, whereby it is loſt to the chemiſts, and thence ſuppoſed to be deſtroyed: And alſo, that it is not generated in efloreſcences, putrefactions, fermentations, &c. but only diſengaged, or attracted from contiguous bodies.

Obſervations and experiments, ſhewing the acid matter ſolitary or pure, or nearly ſo, and demonſtrating that it is an elementary matter, altho' not heretofore known or noticed as ſuch.

Obſervations and experiments, ſhewing that the atoms of acid element repel each other;

ther; and ſhewing the ratio of this repulſion at given diſtances; and that by reaſon of this repulſion, varied by diſtance, this element is an elaſtic, compreſſible, expanſible, inviſible fluid.

Experiments ſhewing the atomary repulſion of acid element counterpoiſed by the attraction of other matter, and the formation of fluids of greater denſity, but yet inviſible; And next, the atomary repulſion of acid element overpowered by the attraction of other interpoſed matter to the acid atoms, which are thus approximated ſufficiently to form an aqueous fluid; and laſtly, the atomary repulſion of acid element ſo much overpowered by the attraction of other interpoſed matter, that ſolid ponderous maſſes are formed therewith.

Conceits of acid air, vitriolic air, acetous air, nitrous air, &c. corrected. The true cauſes of ebullition, intumeſcence, effervefcence; and the uſeful application of this knowledge in practiſe, exhibited.

Experiments and calculations, aſcertaining the diſtance, to which the repulſion between the atoms of acid can be extended with a force equal to the preſſure of the atmoſphere. The force of this repulſion further conſidered at greater and ſmaller diſtances.

Experiments and obſervations authorzing poſitions equally applicable to acid and the foregoing elements; and ſuggeſting that repulſion and attraction, which are forcible in contact, leſs forcible but yet menſurable at various diſtances, do extend to diſtances indefinite, altho' not perceptible to our imperfect organs of ſenſe.

Experiments and inductions, explaining the conditions in which acid, like other matter, is inviſible, viſible, fluid, ſolid, compreſſible, incompreſſible; and perſuading that acid, like other matter, reduced to a ſtate in which it eludes vulgar obſervation, is nevertheleſs identical, incommutable, indeſtructible: And that attraction and repulſion being indefeſible properties of acid as well as of other matter, ſuffer no ſuſpenſions, fits or intermiſſions, and never are commuted in any circumſtance or diſtance, but only balance or overpower one the other, and thus occaſionally ſeem to be deſtroyed, or not to exiſt.

Obſervations and experiments on the acid element and acid compounds, and inductions confirming the foregoing doctrines concerning elaſticity, fluidity, ſoftneſs, hardneſs, plaſticity, ductility, brittleneſs.

Experiments to determine whether the acid element conveys ſound.

Obſervations and experiments, ſhewing the polarity of the acid element, and the difference of the aggregations formed by fortuitous arrangement, from thoſe formed by polar arrangement, of this elementary matter in combination

Obſervations and experiments on the acid element and acid compounds, and inductions generalizing and confirming the foregoing doctrines concerning ſaturation, its cauſes, and extenſive effects in nature.

Experiments, ſhewing that elementary acid attracts earth; and experimental eſtimations of the force of this attraction in contact, and at given diſtances, in arrangement fortuitous, and arrangement polar.

Diagrams, explaining various phenomena, which at firſt view ſeem repugnant to the foregoing doctrines.

Experiments, ſhewing that acid element attracts water: Experimental eſtimations of the force of this attraction in contact, and at given diſtances.

Experiments, ſhewing that acid element attracts alkali.

Experimental eſtimation of the force of this attraction in contact, and at given diſtances.

The incompetency and errors of the tables of elective attractions demonſtrated; and comprehenſive tables commenced, in which the blanks are to be filled up as faſt as experiment will authoriſe.

The ſum of the attractions and repulſions of acid element conſidered; and the gravitation of acid deduced from the foregoing attractions, as an effect, and excluded as abovementioned from the liſt of primary laws of nature.

The former doctrines concerning fixity, volatility, ſpecific gravity, generalized and confirmed.

Of Air.

Review of the pneumatic experiments, and doctrines which are unexceptionable, and ought to be aſſumed on the preſent occaſion.

Experiments and obſervations, ſhewing that atmoſpheric air contains various matters different from the aerial element; ſhewing the difficulty of obtaining any conſiderable quantity of pure air; the errors into which experimental philoſophers have been led, by the impurities of atmoſpheric air; and the methods whereby theſe and other errors may be in future avoided.

Experiments and obſervations, ſhewing that the atoms of air repel reciprocally; and eſtimations of theforce of this repulſion, in contact and at various diſtances of the aerial atoms.

Experiments, ſhewing the atomary repulſion of air balanced by the attraction of air to other interpoſed matter, and the conſequent formation of an elaſtic inviſible fluid of greater denſity than air hath, in like circumſtances of atmoſpheric or mechanical preſſure; And ſhewing the atomary repulſion of air overpowered by the attraction of air to other interpoſed matter, and the conſequent formation of an incompreſſible, viſible, palpable fluid; and laſtly ſhewing the atomary repulſion of air, ſo much overpowered by the attraction of air to other interpoſed matter, that incompreſſible, palpable, ſolid ponderous maſſes are formed thereby.

Inductions from the premiſed experiments, importing that the atoms of air, however approximated, combined, or detached from compounds, are never commuted or deſtroyed; that there is but one aerial element; that the elementary repulſion of air, which cauſes elaſticity, being a law of nature, is never ſuſpended, but only counteracted; that the elaſticity of air cannot be impared by mechanical force as hath been ſuppoſed; that air is not indefinitely compreſſible; that the volume to which a portion of atmoſpheric air can poſſibly be reduced by mechanical force, may be truly eſtimated; and that neither air nor any other known matter attracts at one diſtance and repels at another diſtance; but that air and all known matters attract at every diſtance thoſe bodies which they attract at any diſtance, and repel at every diſtance thoſe bodies which they repel at any diſtance.

Remarks on the pneumatic electrical and other experiments, which have led philoſophers into notions repugnant to the foregoing.

Obſervations on the imperfections of the air pump and other pneumatic machines, and on the advantages and diſadvantages of our apparatus.

Experiments and obſervations, ſhewing that pure air repels earth.

Experiments and obſervations, ſhewing that air doth attract water.

The phenomena of evaporation, exſiccation, hygrometers, deliquiation, humidity, ſweating walls, and water diſtilled from air; the phenomena which have ſuggeſted the notion of the converſion of mercury and various other bodies into water, &c. &c. deduced from the premiſes.

Eſtimation of the force of this attraction in contact, and at various diſtances of the atoms of air and water.

Queſtion. Doth pure air attract pure alkali, or repel alkali; or neither attract nor repel alkali; which latter may be called neutrality.

Reaſons why neutrality ought to be rejected; and why, as the affirmative of the queſtion implies attraction, the negative implies repulſion.

Experiments, in order to * decide on the queſtion.

Whatever may be the event of theſe experiments, it may be remarked, that neither attraction nor repulſion of air to alkali is aſſumed in any part of the following doctrines; that in purſuing nature we ought rather to leap over ſmall obſtacles than loſe ſight of nature by waiting to remove them; and that it is better to paſs the attraction or repulſion of air to alkali, unnoticed, than to expend much time on a ſubject of no great importance, or to admit a dubious poſition.

Experiments and obſervations, ſhewing that air doth attract acid, and ſhewing the properties of the bodies formed by this combination.

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* It is preſumed that a repulſion between air and alkali will be demonſtated.

The theory of ſaturation further confirmed.

Experiments in order to analyſe the nitrous acid compleatly.

Compariſons of the attractions and repulſions of air, and of the quantity of matter which attracts air, with the quantity of matter which repels air; and inferences ſhewing the gravitation of air is the effect of the foregoing elementary attractions, &c. and not a primary law of nature.

Application of the premiſed experiments and doctrines, concerning air and the preceding elements, towards explaining the motions, impulſe, and vibrations of air, our ſenſe of which is expreſſed by the words blaſt, crack, ſound, tones; towards the illuſtration and confirmation of the foregoing theories of viſibility, inviſibility of matter, and of ſaturation, and of fluidity, ſolidity, elaſticity, &c. and towards explaining the agency of air, in the proceſſes which we expreſs by the words tarniſhing, ruſting, mouldering, corruption, rotting.

Review of the experiments which gave riſe to the opinion that the atoms of air are larger than thoſe of water.

The phenomena of theſe experiments, and particularly the free paſſage of water thro' bodies which are not pervious to air, deduced and explained from the premiſes.

Phlogiſton.

Recital of experiments, obſervations, and arguments, repreſenting the imperfections of our ſenſitive organs, and the neceſſity of employing our rational faculties in order to aſſiſt and correct common perception, in the inveſtigation of elements much more ſubtile than the foregoing, as pervading all inſtruments and veſſels.

Combuſtion and ignition experimentally diſtinguiſhed; definition of theſe words.

Experiments demonſtrating that none of the foregoing elements, nor of the bodies compoſed of them, are combuſtible, altho' they may be ignited or charged with fire.

Experiments demonſtrating that all the foregoing elements (except water) and all compounds of theſe elements, can be charged with another matter ſo as to become combuſtible.

A claſſical arrangement on the table of earthy, acid, alkaline, aerial bodies, and combinations of theſe, charged, in the ordinary proceſſes of nature, with matter which renders them combuſtible.

Experiments, ſhewing the ſame bodies artificially charged with a matter which renders them combuſtible, and that both nature and artificial compounds containing this matter, are in the act of combuſtion deprived of it; and that after this privation they are not combuſtible.

Reaſons why the combuſtible bodies are called phlogiſtic bodies, and why the matter whereby they are rendered combuſtible, is properly called phlogiſton.

Compariſons of the foregoing elements and compound bodies conſiſting of them, with the like elements and compound bodies charged with phlogiſton; and experiments, ſhewing that altho' combuſtibility is a proof of the preſence of phlogiſton; incombuſtibility of bodies is not a proof that they contain no phlogiſton, but only that they retain it by the more forcible attractions.

Experiments and obſervations, demonſtrating that the phlogiſtic matter in ethers, ſpirits, oils, balſams, reſins, gums, mucilages, vegetables, charcoal; in all animal ſubſtances; in petrolia, amber, aſphaltum, mineral-coal, and all combuſtible mineral bodies; in all ores, and metals, and in all known bodies; is transferable to other non-phlogiſtic bodies, and from any one body to another, in certain gradations directly or in any ſeries by artificial means; forming new comopunds with all bodies except water; and that this matter after having undergone numerous transfers, combinations, expoſures to fire, &c. ultimately forms with acid, alkali, earth, air, the compounds formed by theſe in native combination with phlogiſton, or by theſe in any artificial combination with the phlogiſton of any body.

Obſervations on the foregoing experiments, and other experiments ſhewing, that phlogiſton is a matter ſubtile, elaſtic, inviſible, incommutable, indeſtructible, incapable of decompoſition, differing remarkably from thoſe already mentioned; that phlogiſton is a diſtinct element; and that there is but one phlogiſtic element.

Obſervations on the experiments on phlogiſtic bodies, and freſh experiments ſhewing, that as phlogiſton, in paſſing from theſe bodies, or when detached in theſe experiments, paſſes through the veſſels and eludes common obſervation; the combinations in which it is rendered viſible or palpable, are to be well examined, previous to the further conſideration of this elementary matter; that the eye of reaſon may co-operate with common perception, in the inveſtigation of the properties where-with the phlogiſtic element is endued.

Experiments, demonſtrating that phlogiſton doth attract air; that this attraction is one of the agents in combuſtion; that air and phlogiſton ſaturate each other, and that the compound of phlogiſton and air hath properties different from thoſe of the component elements. Experiments exhibiting theſe new properties; and diagrams ſhewing they are the neceſſary effects of the attraction of phlogiſton to air balanced by the repulſion ſubſiſting between the ſimilar atoms of theſe elements, agreeable to the doctrine of ſaturation already eſtabliſhed.

Experiments ſhewing that the atoms of phlogiſton and air, are approximated by their mutual attractions to each other, inſomuch that both phlogiſton and air occupy leſs ſpace when mixed, than either occupies when pure, under any given preſſure atmoſpheric or mechanical; and that the compound of phlogiſton and air is, in like circumſtances of atmoſpheric preſſure, a denſer fluid than air, and is ſpecifically heavier than atmoſpheric air.

Inductions from the premiſes, and diagrams explaining why, phlogiſton and air which attract each other, do not form a maſs;

and why they form an inviſible, expanſible compreſible fluid.

Experiments ſhewing, that air ſaturated with phlogiſton, is incapable of attracting phlogiſton.

Inductions from the premiſes, and diagrams, ſhewing this to be the neceſſary effect of ſaturation; and that by reaſon of ſaturation, phlogiſticated air doth not aſſiſt or maintain combuſtion.

Experiments ſhewing that phlogiſticated air combines with bodies which attract either phlogiſton or air, and conſequently combines with bodies which do not attract pure air or pure phlogiſton.

Inductions and diagrams, ſhewing this latter property of phlogiſticated air to be the neceſſary conſequence and effect of the laws of nature already demonſtrated.

Experiments, ſhewing that phlogiſticated air, which is an elaſtic inviſible fluid, not greatly exceeding pure air in ſpecific gravity, forms with other inviſible elaſtic fluids which attract it ſtrongly, ponderous, viſible, palpable maſſes. Theſe phenomena deduced from the premiſes.

Experiments, ſhewing that phlogiſticated air is transferable without decompoſition, from one body to another, and that the number of theſe transfers already diſcovered, is very great; and that the phenomena attending them, correſpond with, and confirm the foregoing doctrines.

Experiments, ſhewing various other properties of phlogiſticated air, its fatal effects on animals, its effects on the electric matter, &c.

Recapitulation of the foregoing properties of phlogiſticated air, *viz.* the ſpecific gravity, compreſſibility, expanſibility, inviſibility, incapacity to maintain combuſtion; the effects in combinations; the gradations of its attractions to other bodies; the circumſtances in which it is formed; the proceſſes in which it is detached; the circumſtances in which it is transferred; the effects of it on animals, on the electric fluid, &c. All ſhewing, that phlogiſticated air is the ſame matter which modern philoſophers call *fixable air*.

Experiments ſynthetic, ſhewing that phlogiſticated air, or fixable air, is always compoſed wherever and however pure phlogiſton is mixed with pure air.

Obſervations on the experiments in which fixable air is formed, ſhewing air to be neceſſary and phlogiſton neceſſary, for the formation of fixable air; and that no matter, except phlogiſton, and air, and light, is preſent in every experiment in which fixable air is formed.

Concluſions from the premiſes, importing, that fixable air may, by heterogeneous admixture, aſſume various appearances; but that fixable air is a compound of phlogiſton and air only.

Inferences concerning the fixable air from ſolutions, ignitions, combuſtions, fermentations, animal digeſtion, reſpiration; and concerning damps of the miners, and noxious ſubterranean cavities. The varieties obſerved in fixable air formed in various circumſtances accounted for; and applications of this knowledge to practice, in experimental and trading chemiſtry, and in the imitation of mineral waters.

Experiments analytic, ſhewing that phlogiſticated air may be decompoſed; that it is decompoſed by the means and in the circumſtances neceſſary for the decompoſition of other phlogiſtic bodies; that this decompoſition is a proceſs daily performed by nature; that air and phlogiſton are diſcovered in all theſe decompoſitions, and no other matter whatever; that the air ſevered from phlogiſton, has all the properties of atmoſpheric air, and none of thoſe peculiar to fixable air; that the phlogiſton thus ſevered from air, hath all the properties of phlogiſton,

ſton, and none of thoſe peculiar to fixable air: concluſions that fixable air is a compound, and conſiſts of phlogiſton and air, and of nothing more.

Obſervations on the uſes of fixable air, and the circulation of it in nature; until it is decompoſed, and its conſtituent air is diffuſed in the atmoſphere or elſe-where; and its conſtituent phlogiſton is lodged in bodies, or contributes to the growth, maſs and combuſtibility of vegetables.

Eſtimation of the force wherewith phlogiſton attracts air.

Experiments and obſervations, ſhewing that phlogiſton attracts alkali; and exhibiting the phenomena of this combination: the phenomena explained according to the theory of ſaturation.

Eſtimation of the force of this attraction, in contact and at various diſtances of the atoms.

Experiments and obſervations, ſhewing that phlogiſton doth attract acid; that theſe ſaturate each other; that the compound of phlogiſton and acid hath properties different from thoſe of the component elements; and that theſe properties correſpond with the doctrines already advanced concerning attraction, repulſion and ſaturation, and tend to eſtabliſh them; in a much as in natural philoſophy we can have no ſtronger proof of the truth of any doctrine, than its conſonance with the natural phenomena.

Experiments ſhewing, that the atoms of acid are approximated by phlogiſtic atoms interpoſed, and that nevertheleſs phlogiſton and elementary acid do not form a ſolid maſs, or palpable fluid, but only an elaſtic inviſible fluid.

Inductions from the premiſes, and diagrams, explaining why the compound of phlogiſton and acid doth aſſume the foregoing form or condition, and no other.

Experiments, ſhewing the combuſtibility of this inviſible compound of acid and phlogiſton; and that this compound, like other phlogiſtic bodies, requires the concurrence of air and fire towards its combuſtion. The various phenomena of the combuſtions of this inviſible fluid explained, according to the premiſed laws of matter.

Recapitulation of the demonſtrated properties of the combination of acid and phlogiſton, ſhewing that this is the matter which modern philoſophers call INFLAMMABLE-AIR.

Experiments ſynthetic, ſhewing that inflammable air is compoſed, whenever pure phlogiſton is preſented to acid pure, or nearly pure; but that the compound acid matter, called nitrous acid, is not only unfit for this purpoſe, but prevents the formation of inflammable, air in all circumſtances yet diſcovered.

Obſervations on the experiments in which inflammable air is compoſed, or is detatched from bodies by fire; and obſervations on the places and circumſtances in which it is found native; all ſhewing, that acid and phlogiſton are neceſſary to the formation of inflammable air; and that no matter, except phlogiſton, acid and light, is common to all, or preſent in all theſe experiments and places, in which inflammable-air is formed.

Obſervations, on the inflammable air detatched or formed in ſolutions, decompoſitions, fermentations, putrefactions, vitriolizations, ignitions; in diſtillations of microcoſmic ſalt with phlogiſtic matter, in diſtillations of oils, æthers, and various phlogiſtic compounds: obſervations on native inflammable air, fire damps, &c; all ſhewing, that inflammable air, by reaſon of heterogeneous admixture, doth aſſume various appearances; but that inflammable air is a compound of acid and air.

Applications of theſe doctrines, concerning inflammable air, to chemical practice, and to the art of compoſing artificial meneral waters.

Experiments ſhewing that inflammable air may be decompoſed, and that it is decompoſed in the ordinary courſe of nature.

Concluſions from the analytic as well as the ſynthetic experiments, importing that inflammable air conſiſts of phlogiſton and acid, and of nothing more.

Obſervations on the circulations of inflammable air, and the continuance of theſe circulations, until its acid is drawn away by other matter, and its phlogiſton is attracted by non-phlogiſtic bodies, to form phlogiſtic combinations, or to contribute to the maſs and combuſtibility of vegetables.

Experiments and obſervations ſhewing that phlogiſton attracts earth.

Eſtimation of the force of this attraction in contact and at given diſtances of the atoms.

Comparative eſtimation of the attraction of phlogiſton to earth, to alkali, acid, and air.

Digreſſion concerning alchemiſtic enquiries; vindication of alchemiſts, and cautions againſt the dangers of alchemy.

Examination of the opinions concerning Fire, and particularly the opinion prevalent with modern philoſophers, who ſuppoſe that Fire is a certain motion of matter.

Confutations of theſe opinions.

Experiments and obſervations, ſhewing that Fire is a matter different from any matter treated of previous to phlogiſton; and that motion is not neceſſary to the exiſtence of fire.

Experiments and obſervations ſhewing, that the attraction of phlogiſton to the foregoing elements, or bodies compoſed of them, is counteracted, or in effect weakened, by fire; and particularly that the attraction of phlogiſton to air, is counteracted, or in effect weakened, by the introduction of fire.

Experiments and obſervations, ſhewing that pure phlogiſton doth not attract pure water, and is not combinable with water; except by means of ſome matter interpoſed, which attracts both phlogiſton and water; but that phlogiſton nevertheleſs eaſily pervades water.

Inductions from the premiſes, explaining how repellent elements are combined by means of a third element; and how compounds which will not unite, are by means of a third compound united; and how bodies, which will not cohere, are, by means of a third body, made to cohere; and explaining various other phenomena, which may be ranked under the following heads, *viz.* Intermediums, cements, wetting, ſcouring, inflammable bodies ſoluble in water, inflammable bodies not ſoluble in water.

Experiments and obſervations, ſhewing that the atoms of phlogiſton attract other atoms more forcibly in one axis of each atom than in any other; or, that phlogiſton like other elementary matter hath polarity.

Experiments, ſhewing that many nonphlogiſtic bodies, accurately weighed, and then combined with conſiderable quantities of phlogiſton, acquire no additional abſolute gravity by this acceſs or addition of phlogiſton.

Other experiments ſhewing, that the abſolute gravity of many non-phlogiſtic bodies, is conſiderably counteracted or in effect leſſened by combining theſe bodies with phlogiſton; and ſhewing, that theſe bodies, whoſe abſolute gravity hath been leſſened in the foregoing manner, acquire or reſume a greater abſolute gravity, when they are deprived of phlogiſton, than they had whilſt they retained the phlogiſton: inferences from theſe experiments, perſuading that phlogiſton doth not gravitate, and that it hath a power whereby it counteracts the gravitation of other matter.

Eſtimations of the attractions of phlogiſton; of the repulſions of phlogiſton; of the relative quantities of different elementary matters in the terraqueous globe which attract phlogiſton, and of the quantities of matter in the terraqueous globe which repels phlogiſton.

Concluſions, implying that the ſum of the repulſions of phlogiſton, exceed the ſum of the attractions; and conſequently, that if gravitation be an effect, and not a primary law of nature, as hath been advanced, phlogiſton ought not to gravitate; and ſince it is experimentally found not to gravitate; that the foregoing theory of gravitation is further confirmed.

The levity and volitility of æthers, ſpirits, oils and various inflammable bodies, and other phenomena, of a ſimilar nature, occuring in the practice of chemiſtry, in arts, and in the great elaboratory of nature, deduced from the premiſes.

Compariſons of the ſpecific gravity of phlogiſtic bodies with that of other bodies: arguments in addition to thoſe already uſed, perſuading, that ſpecific gravity and denſity are not commutable terms, as the moſt celebrated philoſophers have aſſumed and uſed them; that there is not neceſſarily more matter in a cubic inch of glaſs than in a cubic inch of reſin; nor larger pores or interſtices in the reſin than in the glaſs; altho' the ſpecific gravity of glaſs be much greater than that of reſin; and finally that gravity depends as much on the ſpecies of the gravitating matters, as on the quantity of them.

Experiments and obſervations, ſhewing, that phlogiſton, when detached in ſaturations, fermentations, decompoſitions, native vitriolizations; in combuſtions, culinary, chemical, phoſphoric; in colliſions frictions, &c. is either Fire, or is a conſtituent elementary ingredient of Fire.

Experiments and obſervations, ſhewing, that phlogiſton, whether in combination, or detached, is *not* fire; that fire, whether in bodies, or parted from them, is not phlogiſton; and that fire differs from phlogiſton, as much as any known compound differs from its component elements.

Inductions, implying that ſince phlogiſton is not fire, but is a conſtituent ingredient of fire, fire is a compound body conſiſting of phlogiſton and ſome other matter.

Enumeration of the former experiments, which ſhew that the bodies formed with phlogiſton, and the elements and compounds hitherto examined, are totally different from fire; and enumerations of the demonſtrated properties of all the elements

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and compounds, treated of previous to phlogiſton; ſhewing, none of theſe can be an ingredient or component part of fire.

Inductions, perſuading, that as fire is a compound, containing none of the foregoing elements, except the phlogiſton now under conſideration; and as we know no other element, ſaving light, wherewith phlogiſton can form a compound poſſeſſing the properties of fire; we may reaſonably preſume that fire is compoſed of phlogiſton and light, and of no other matter whatever.

A digreſſion concerning light, with demonſtrations of the properties of that element which relate to the preſent ſubject.

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Read the firſt twenty paragraphs on Light.

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Experiments and obſervations, ſhewing, that fire hath properties different from thoſe of phlogiſton, and from thoſe of light, and correſponding with the doctrine of ſaturation; that the general properties of fire, are intermediate between thoſe of phlogiſton and light, in the ſame manner as the general properties of other compound bodies are intermediate between thoſe of their component elements; and that we are led, by general analogy, to conſider fire, as a compound of phlogiſton and light.

The arguments *a priori*, and the arguments from analogy; ſupported by arguments *ex abſurdo*, perſuading that fire is compoſed of phlogiſton and light.

The foregoing aſſertion further ſupported on the following grounds:

That it is preſumed to correſpond with the natural phenomena; that nothing will appear repugnant to it in our future experiments; that by admitting it, we ſhall explain appearances which are otherwiſe inexplicable; and be enabled to prognoſticate the reſult of many new experiments.

Reaſons for not introducing theſe teſts in this place; and why theſe teſts, wherever introduced, render the foregoing aſſertion as credible as any other aſſertion admitted in natural philoſophy..

Obſervations and Experiments ſhewing, that phlogiſton doth attract light; that theſe elements ſaturate each other; and that it is poſſible truly to eſtimate the force of this attraction, in the ſame manner as the attraction of other elements hath been eſtimated.

Experiments on combuſtion, ſhewing the circumſtances neceſſary thereto.

EXPERIMENTS.

Firſt, On bodies, which, for their combuſtion require no ignition; *ſecondly*, on bodies, which, for their combuſtion, require nearly the quantity of ignition given by a flint-ſpark: *thirdly*, on bodies, which, for their combuſtion, require nearly the quantity of ignition given by tinder: *fourthly*, on bodies which, for their combuſtion, require nearly the quantity of ignition given by the blaze of a taper; *fifthly*, on bodies, which, for their combuſtion, require the ſeveral intermediate degrees of heat, between thoſe of the taper and of the fierceſt furnaces.

Experiments exhibiting the combuſtions which are extremely ſlow, and are accompanied with no perceptible heat: experiments exhibiting the combuſtions which are quicker, in their progreſs, than the foregoing, and are accompanied with various degrees of heat: experiments exhibiting the combuſtions which are rapid in their progreſs, and are accompanied with intenſe heat: all at the ſame time, exhibiting the agency of air in combuſtion; the inefficacy of phlogiſticated air; and the retardation of combuſtion, by every means whereby the air meets impediment, or undergoes alteration.

Experiments, ſhewing that ſome phlogiſtic bodies, may, by the gradual application of fire, be ſooner evaporated than inflamed, even in the preſence of air; but may ſooner be inflamed than evaporated, by any other application of fire, in concurrence with air; and further ſhewing that ſuch bodies conſiſt of repellent elements, are weakly aggregated, gravitate weakly, and are eaſily volatilized by fire.

Experiments, exhibiting detonations and exploſions; commencing with thoſe of ſmall force and ſlow progreſs; and proceeding thro' numerous gradations, to thoſe which are inſtantaneous and forcible in the higheſt degree; exhibiting alſo the elementary matters concerned in theſe exploſions, and the manner in which they operate on each other, to cauſe exloſion, and various other phenomena.

Experiments and obſervations, on burning lamps, candles, flam-beaux, &c. The combuſtions of oils, tallow, ſpermaceti, wax, &c. compared. Obſervations on the uſe of wicks. Obſervations on the commencement and progreſs of theſe combuſtions. Obſervations on the extinctions and revivals of theſe combuſtions, by currents of air and other means.

Obſervations on the phenomena accompanying the formation of burrs or ſnuffs, and various poſitions of wicks.

Ob-

Obſervations on the effect of ſnuffing candles.

Experiments, exhibiting the phenomena of combuſtions checked by water or ſucculence, and of combuſtions extinguiſhed by water, fixable air, and other fluids.

Experiments exhibiting the unextinguiſhable combuſtions.

All the foregoing phenomena of combuſtion, detonation, exploſion, explained; and ſhewed to be the neceſſary reſult of the various kinds, and of the ſpecific properties of matter already mentioned; confirming the preceding doctrines, and particulary that of fire.

Experiments and inductions, ſhewing that the intenſity of fire, is in the direct ratio of the quantity of fire compoſed or retained in any given ſpace, in every inſtant of any given time; And that every degree of fire or heat, from that which we call temperature, up to the furnace heat, hath the like relation to time and ſpace.

Experiments and inductions ſhewing that blaze differs from fire, in its properties and in its compoſition: and ſhewing that blaze is a *mixture* of fire and phlogiſtic matter which hath not yet formed fire.

Experiments exhibiting various phenomena of ſmoak, ſoot, and the reſiduary matter of combuſtions.

Inductions from theſe experiments, and obſervations on combuſtion, fire, blaze, ſmoak, ſoot and reſiduary matter; confirming the foregoing doctrines, and uſeful or explanatory in arts.

Inductions from the foregoing experiments, importing, that air is not a neceſſary ingredient in fire; that it is not a *pabulum ignis*, as philoſophers have imagined; and that it is no otherwiſe neceſſary in combuſtion, than as an agent, in the extrication of phlogiſton, from the other matter of combuſtible bodies.

Experiments ſhewing the different effects of furnaces differently conſtructed; how furnace heats, greatly exceeding thoſe heretofore known, may be excited; how fire may, moſt equably and conveniently, be applied to large maſſes of matter, and to great diſtances; how to manage fuel to the greateſt advantage; and how to make choice of fuel for various purpoſes.

Theory of the draught of chimnies, of the conſtruction of furnaces, kilns and fire-places; and theory of the other ſubjects of the laſt paragraph; founded on the premiſed experiments and properties of matter.

The management, uſes and effects of the blow-pipe, ſhewed and explained.

Experiments and obſervations pointing out improved methods of burning ſmoak; of extinguiſhing accidental fires in certain circumſtances; of curing ſmoaky chimneys, however ill conſtructed, by alterations in the ſtoves only; and pointing out improvements in arts which require the application of fire.

Experiments and obſervations ſhewing that fire is an elaſtic fluid; that this elaſticity is a neceſſary effect of the demonſtrated properties of phlogiſton and light; and that the power which cauſeth this elaſticity, is repulſion; which hath been demonſtrated to be the cauſe of elaſticity in other fluids.

The theory of ſaturation introduced, and digrams preſented, in order to ſhew more clearly, why light, which attracts phlogiſton, doth not form therewith a ſolid maſs, or denſe fluid, but only an elaſtic fluid.

Review of the experiments which ſhewed the ſubtility of phlogiſton and of light; and inductions importing that the capacity, which fire hath to pervade all bodies, is the neceſſary reſult of the demonſtrated properties of the compotent elements of fire; and that from this property of fire, no exception ariſeth againſt the doctrine of ſaturation; in as much as that doctrine doth not teach that the ſize of elementary atoms can be altered, nor that molicules can be formed until the atoms are in contact.

Inductions from the properties of light and phlogiſton, and from various experiments and obſervations on fire; importing, that fire is capable of receiving and communicating motion.

Experiments and obſervations ſhewing, that bodies whoſe elementary atoms are held in contact by the more forcible attractions, are leaſt expanded by a given charge of fire; that fluids whoſe atoms are approximated by the leſs forcible attractions, are moſt expanded by the like charge of fire; and that ſolids, or fluids, whoſe atoms are cloſely approximated, or held in contact by attraction intermediate between the foregoing, in force, are expanded to degrees intermediate between the foregoing, by the like charge of fire.

Experiments and obſervations ſhewing, that ſolid bodies, which are expanded by a ſmall charge of fire, are ſoftened by a greater charge of fire; are rendered fluid or fuſed by a charge of fire ſtill greater; and are thrown into vapour, by a charge of fire much greater than the foregoing charges.

Experiments and obſervations ſhewing, that fluids, are expanded by a ſmall charge of fire; are thrown into vapour expanding with ſome force, by a greater charge of fire; and that this vapour is made to expand with much greater force, by much greater charges of fire, than the foregoing.

Theory of the Thermometer.

Conſiderations of the foregoing experiments and obſervations:——Conſideration that fire cannot expand or deſtroy attraction, which is a law of nature:—Conſideration that attraction is moſt forcible in contact, and decreaſes in ſome regular inverſe ratio of the diſtance of the atoms:—Inductions from theſe experiments, obſervations, and facts conſidered; importing, that fire hath the power of counteracting attraction, by reaſon of its capacity to remove contiguous atoms of bodies to a diſtance from each other. Inductions in like manner importing, that hardneſs, ſoftneſs, fluidity, and the vaporous ſtate, to which bodies are reduced by fire, are effects; the firſt, of powerful attraction in contact of the atoms; the ſecond, of attraction counterpoiſed; the third, of attraction weakened by diſtance; the fourth, of attraction weakened very much by reaſon of the greater diſtances of the atoms.

Experiments ſhewing, that fire, applied contiguous to a body, and not confined by that body; but on the contrary left at liberty to expand and diffuſe itſelf on all ſides, except on the coaſt of that body; will nevertheleſs expand that body, however ſolid and tenacious it may be. Compariſon of theſe things, with the aſſertions, *that fire is matter, and that it is an elaſtic fluid.*

Queſtions ariſing from the foregoing experiments and aſſertions, viz.

Why doth not fire flow off on the ſide where it finds leaſt reſiſtance?

Why doth fire, which is at liberty to flow off on all ſides, except one, nevertheleſs enter a ſolid body, and expand it, in deſpite of the forcible attraction whereby the atoms of that ſolid body reſiſt ſeparation?

Theſe queſtions anſwered conſiſtently with the premiſes.

Inductions explaining how fire ſevers the attoms of bodies from each other; how it expands, ſoftens, fuſes, and vaporizes bodies.

Conſiderations on various occurrences in chemiſtry and arts, ſuggeſting, that the force of fire, in expanding bodies, is not indefinite. Experiments in order to examine the truth of the ſuggeſtion.

Obſervations on the uſe and abuſe of the word heat; and ſhewing, that it expreſſes only our ſenſe of certain *effects* of fire; and that if *latent effect*, or *latent ſenſe*, are expreſſions contradictory and unphiloſophic; the phraze *latent heat*, conveys no clear ideas, and ought never to be uſed in chemiſtry or natural philoſophy.

Experiments and obſervations ſhewing, that heat, or degrees of heat, are as the quantity of fire in a given body or ſpace.

Review, of the experiments and natural proceſſes, in which phlogiſton is detatched and doth not form fire; and of the experiments and natural proceſſes, in which phlogiſton is detatched and doth form fire.

Obſervations on the times, diſtances, and circumſtances, in which the effects of fire do ceaſe; and on the transfers and privations of fire.

Inductions importing that cold, is privation of fire; and further, that the powers, whereby phlogiſton, detatched from combuſtible bodies, is prevented from forming fire; may effect the decompoſition of fire.

Experiments and obſervations, purſuant to the foregoing inductions, perſuading, that fire is actually decompoſed, in various artificial and natural proceſſes; and that this decompoſition of fire, is one of the cauſes, whereby cold is produced.

Experiments ſhewing, that, when a body is ſuddenly expanded, by reaſon of its own elaſticity, or by any power except that of fire; then cold is produced in that body, and in the vicinity of it.

Experiments ſhewing, that when any body is ſuddenly contracted in its dimenſions, ſo far as to occupy a ſpace much ſmaller than it did in it's former ſtate; then heat is produced in that body and in the vicinity of it.

Theſe and all known productions, of heat and cold, explained, and deduced from the premiſes.

Inductions, importing, that heat is produced, in two ways: *firſt*, by the formation of fire; and *ſecondly*, by compacting the fire, which was diffuſed in a voluminous body, into a ſmall body or ſpace. Inductions importing, that cold alſo is produced, in two ways: *firſt*, by the decompoſition of fire; *ſecondly*, by cauſing the fire, which was contained in a ſmall compaſs, to expand into a large compaſs.

Experiments and obſervations on the circulations of phlogiſton; from the compound called fire, to the bodies in which it is lodged, therewith forming inorganic combuſtible bodies; and from the compound called fire, until it contributes to the vegetation and maſs of combuſtible vegetables.

Enumeration of various natural and artificial operations, and of phenomena, which have not been noticed ſufficiently in the preceding inveſtigations: Reaſons why theſe ſubjects may be now conſidered, in any order; and why they may be propoſed in the form of queſtions; in order to ſhew, that the anſwers to theſe queſtions muſt be founded on the foregoing doctrines, and no others; and conſequently that theſe anſwers confirm the premiſes; inaſmuch as the credibily of all doctrines in natural philoſophy, is founded on their correſpondence with, and explication of, the natural phenomena.

Queſtions.

Why is there no encreaſe of heat in the terraqueous globe or in the vicinity of it; in conſequence of the quantity of fire hourly formed, in the courſe of many thouſand years?

Why is there no apparent waſte of this our globe; and why is there no deficiency of phlogiſtic matter; in conſequence of the waſte of phlogiſtic bodies in burning, and of the vaſt quantities of phlogiſtic matter hourly formed into fire?

Why are the higher regions of the atmoſphere, colder than the lower regions; altho' fire is evidently buoyant in air?

Why doth the heat of combuſtions not extend, in open quieſcent air, to any conſiderable diſtance, either horrizontally or vertically: and why the heat of combuſtions doth not extend to any great diſtance, even with the wind?

Why fire may, without notable waſte, be carried to a great diſtance from burning bodies, by means of chimnies and tubes of maſſive conſtruction: and why fire is carried from burning bodies, to the diſtance of many miles, in ſubterraneous cavities, without notable waſte?

What is the cauſe of meteors, fire balls, and luminous miſts?

Why doth fire affect an equilibrium in bodies and ſpace; and why doth it appear to have no *notable* appetence or attraction to any one maſs of matter, above any other?

What is the cauſe of condenſation?

Why doth a receiver, capable of containing only a quart of water, ſerve to condenſe as much vapour, in a given time; as can be condenſed in a receiver capable of holding one hundred quarts or more?

Why are heavy bodies carried away by fire, in a direction contrary to that of their gravitation; or in any direction from the focus of the fire?

Why doth fire decompoſe compound bodies; and effect combinations, and decompoſitions, otherwiſe not feaſible; and often contrary to the order of attraction.

Why bodies, which reſiſt the volatilizing power of fire, with extreme force, are eaſily volatilized, by fire, when they are combined with phlogiſton?

Why do water, ſpirits, and other bodies, when vaporized by fire, mount in atmoſpheric air? and why do they mount to a certain height in the atmoſphere of air, and no further?

What is the cauſe of wind, monſoons, hail, ſnow?

What are the cauſes of fermentation, putrefaction, decay, efflореſcence, inteſtine motion and efferveſcence?

What is the cauſe of the putrefaction of wood, &c.

Why are putrid bodies odorous. And why are many bodies not odorous until they are ſtruck, rubbed, or heated?

Why are putreſcent bodies, long preſerved from putrefaction, by fixable air?

Why is wood long preſerved from rotting, by immerſion in water?

What is the condition of air, when it accelerates putrefaction?

Why is the air in cities, woods, marſhes, cloſe priſons, and ſhips, leſs ſalubrious than the atmoſpheric air in other places?

Why is air which hath been reſpired, inſalubrious to animals which immediately breathe it?

What is the power, whereby potential cauſtics deſtroy the human fabrick, &c. &c.

Light.

Review of the experiments and doctrines of Sir Iſaac Newton and other philoſophers, concerning Light. Vindication of Sir Iſaac Newton, from erroneous opinions aſcribed to him, in conſequence of his Queries.

Various fallacies and inconſiſtencies of the modern theory of optics demonſtrated.

Experiments and obſervations perſuading that light is an elementary matter conſiſting of atoms of the ſmalleſt ſize: That light is not an emanation, or a matter ſent forth by the ſun, or ſtars, or planets, or ſatellites: That light exiſts in all bodies and ſpaces to the utmoſt limits of the known creation: That light viſible, or illumination, is the element of light impreſſing our organs of ſight ſenſibly: That darkneſs is not the abſence of light, or any privation of light.

That darkneſs is only a word, expreſſing our inſenſibility of the preſence of light: that the quieſcence of light is the cauſe of darkneſs; or in other words, darkneſs is light at reſt, or in a condition incapable of making a ſenſible impreſſion on our organs.

That illumination (commonly called light) and darkneſs, are with reſpect to light, what ſound and ſtillneſs are with reſpect to air.

Obſervations on the errors induced in optical reaſoning, by confounding the ideas of illumination, and light; by uſing the word light indiſcriminately to expreſs the element, and our ſenſe of its motion; by the like improper uſe of the words darkneſs and ſhade. Experiments and obſervations concerning ſhade, ſhewing what it really is, and the impropriety of denying the ubiquity of light, becauſe illumination, vulgarly called light, doth not bend into the ſhade.

Experiments and obſervations, ſhewing that light is an element conſiſting of atoms which repel each other; and that by reaſon of this repulſion, together with the ſubtility already mentioned, it becomes an elaſtic fluid, capable of pervading all bodies, and itſelf inviſible, altho' the medium of viſion.

Experiments and obſervations, ſhewing that light doth not attract earth or earthy compounds, water or watry compounds, alkali or alkaline compounds, acid or acid compounds, air or aerial compounds, nor compounds conſiſting of two or more of the foregoing, nor any compound formed with the foregoing and phlogiſton; nor any known viſible matter, nor any known inviſible fluid, or matter, except phlogiſton; but that, on the contrary, light repels all theſe bodies, and every known matter except phlogiſton.

Eſtimations of the repulſions of light, of the attraction of light to phlogiſton, of the relative quantities and conditions of matter attracting and matter repelling light; concluſions that light ought not to gravitate to our earth, if gravitation be only the ſum of elementary attractions, or the exceſs of the attractions above the repulſions, as hath been ſuggeſted.

Experiments and obſervations, ſhewing that light doth not gravitate; and why it is equably diffuſed in bodies and in ſpace. Concluſions confirming the foregoing theory of gravitation.

Experiments and obſervations, ſhewing that we have no ſenſe of illumination, or of objects by viſion (or in the vulgar phraſe we cannot ſee light) except when light is actuated by ſome matter in motion; and further ſhewing, that only one ſpecies of elementary matter is capable of thus actuating light; and that this matter is phlogiſton; and that phlogiſton combined with any matter except light, hath not this property during the combination; but that pure phlogiſton and phlogiſton combined with light, that is fire, have this property; and have it only whilſt they are in a ſtate of vibratory motion.

Enumeration of the foregoing experiments, and other experiments and obſervations ſhewing, that light is not moved rapidly and progreſſively in the ordinary courſe of nature, or when it impreſſes us with viſual ſenſe of objects; that no progreſſive motion of light is neceſſary to viſion: but that vibratory motion of light is neceſſary to viſion: that this motion is communicated to light by other matter whoſe motion is vibratory: that light affects the eye by communicated impulſe, as air affects the ear by impulſe, and not by progreſſive motion: and that light hath no laws of motion except what are common to all elaſtic fluids.

Review of the ſeveral experiments, obſervations and doctrines, which incline us to reject the opinion, that the ſun is a maſs of luminous or fiery matter, or that he can emit from his ſubſtance the light or heat perceived when he is preſent, and yet ſuffer no waſte or change; and which incline us to preſume that the ſun is a maſs of matter, not unlike our earth, containing much phlogiſton; and a great part of whoſe ſurface is at once burning, and whoſe fire is decompoſed, and whoſe phlogiſton returns to parts of his maſs formerly burnt, and whoſe ſubſtance is conſequently never diminiſhed; and whoſe fire altho' it doth not paſs away from his atmoſphere, actuates light to great diſtances, as our ſmall fires upon earth do to ſmaller diſtances, or as they would probably do to greater diſtances if viewed vertically thro' the atmoſphere, inſtead of being viewed thro' the turbid air near the earth.

Inductions from the demonſtrated properties of water, air, alkali, acid, phlogiſton, and light; ſhewing why impulſe communicated to all gravitating matter, whether in the form of ſolid maſſes, or inviſible fluids, is to our ſenſes loſt in a ſmall time and ſpace; and hath, within the ſpace, in which it is perceptible, ſlow ſucceſſive communication or progreſs; and why impulſe communicated to light is communicated thro' this fluid almoſt inſtantaneouſly to diſtances unmeaſured; and why it is communicated thro' pure air nearly as well as thro' ſpaces void of air; thro' ſome bodies, nearly as well as thro' air; and thro' other bodies, not in any degree ſenſible to our organs.

Experiments exhibiting the following phenomena and analogies which for the preſent are expreſſed by the cuſtomary terms to avoid prolixity, viz.

The phenomena of reflected light, and reflectors perfect and imperfect; of the angle of reflection; and of paralel, diverging, and converging light; and of foci of light by reflection. The analogy between theſe and ſound, and eccho, and bodies cauſing iterations and increaſe of ſound.

The phenomena of tranſmitted light; of bodies diaphanous perfectly, or imperfectly; of tranſmitted light, diverging, paralel, and converging; of foci of tranſmitted light. The analogy between theſe and ſound communicated thro' bodies. The phenomena, which ſuggeſted the notions of fits of eaſy reflection and fits of eaſy tranſmiſſion, and other fits of light imagined by philoſophers. The phenomena of bodies opaque perfectly, or imperfectly; and the analogy of theſe with perfect and imperfect media of ſound.

The phenomena of foci of light acting on bodies; of the cold focus of the moon, &c. ——

The foregoing phenomena explained and deduced from the premiſed properties of light and other matter; all other properties attributed to light, rejected.

The phenomena of the refractions and inflections of light reſumed: compariſons of the refracting power of phlogiſtic bodies, with that of non-phlogiſtic bodies; and the reflecting power of non-phlogiſtic bodies compared with that of phlogiſtic bodies. The opacity and blackneſs, of certain phlogiſtic bodies, and their incapacity to reflect light ſo powerfully as others do; and the capacity of diaphanous phlogiſtic bodies to refract light more than other bodies do, exhibited.

Explanations of theſe phenomena deduced from the premiſed properties of light, phlogiſton and other matter.

Experiments exhibiting the phenomena of priſmatic colours, and colours by refractions various; and of colours of bodies; and colours induced, changed, and apparently deſtroyed in bodies.

Review explanatory of the mechanical doctrine of communicated motion; and percuſſion of elaſtic bodies; of oblique planes, &c.

The foregoing colours, changes of colour, and deſtructions of colour, explained, and deduced from the premiſed properperties of light and other matter. Concluſions that no other properties of light ought to be admitted.

The received doctrine of colours oppoſed by experiments; and obſervations on theſe and the preceding experiments, perſuading, that light doth not conſiſt of rays differing in their original properties, and impreſſing us with a ſenſe of colour peculiar to each different ray; but that our ſenſe of colour is, our preception of the *modifications* of the vibratory motion of light; and that the ſeven priſmatic colours are, with reſpect to light, what the ſeven tones are with reſpect to air.

Experiments exhibiting the preparation and phenomena of all the known phoſphori; the glow worm and ſome other animals, fiſh and rotten wood being ranked in this claſs. The phenomena of phoſphori explained and deduced from the premiſed properties of light and other matter; or efforts made to this effect.

Conſiderations on the circulations of light, explaining why there is no encreaſe or decreaſe of the quantity of light; and ſuggeſting ſatisfactory anſwers to various queſtions concerning ſun light, moon light, candle light, optical inſtruments, &c.

Review of the experiments and proceſſes, in which heat or fire is produced by mixtures, condenſations, fermentations, putrefactions, friction, percuſſion.

Review of the experiments exhibiting the various modifications of luciferous and igneous matter, from the torrid focus of ſun light, to furnace fires, blazes, warmth, down to the phoſphoric cold luciferous matter, and moon light; review of the properties of phlogiſton and its circulation in our atmoſphere and terraqueous globe; and review of the bodies which become odorous by friction percuſſion and heat; introductory to the experiments preſenting the phenomena of the electrical matter.

The following queſtion propoſed:

Doth the electrical fluid contain phlogiſton?

Obſervations on the materials and circumſtances neceſſary for exciting, accumulating, retaining, and conducting the electric matter: and ſummary view of all the phenomena and arguments, which incline us to believe, that the electrical fluid contains phlogiſton.

Summary view of the obſervations and arguments, which ſeem repugnant to the foregoing opinion concerning electrical matter. Attempts to reconcile theſe with the affirmative obſervations and arguments; and to eſtabliſh the opinion that phlogiſton is a conſtituent elementary part of the electrical matter.

Experiments and obſervations, made with a view to diſcover, whether *the electrical matter is phlogiſton ſolitary and pure*, or phlogiſton combined; or whether the electrical matter is an elementary matter different from all thoſe heretofore mentioned.

Summary view of the foregoing obſervations and doctrines concerning attraction.

Obſervations on the ſeveral ſpecies of attraction adopted by philoſophers, and expreſſed by the words

Attraction of gravitation,
Attraction of aggregation,
Attraction of coheſion,
Attraction of intermediums,
Elective attraction,
Double elective attraction,
Capillary attraction,
Magnetic attraction,
Electrical attraction.

Theſe ſeveral attractions illuſtrated by experiments, and explained, and deduced from the demonſtrated attraction of the elementary atoms.

Queries and ſpeculations concerning the animal œconomy and rational faculties of man; of the queries the following are a ſpecimen:

Quer. Is it not poſſible for men to arrive to a perfect knowledge of all properties of matter hitherto mentioned, and to diſcover the cauſe of all the phenomena hitherto mentioned or implied; except the few ſuggeſted in the next queſtion.

Quer. Is it poſſible for men to comprehend, or reaſon truly on, the properties of matter or laws of nature, or divine diſpenſations, whereby they are enabled to live and reaſon.

Quer. It is poſſible for the mind of man to inveſtigate the cauſe of vital heat, muſcular motion, and ſenſation; or to diſcover what is the nervous influence; what is that life, which a vapour, an electric ſpark, or a bodkin can detatch or deſtroy.

Why is fixable air or phlogiſticated air, which extinguiſhes blaze and conducts electric matter, deleterious to animals which breathe it.

Why do æthers, ſpiritus rectors, vinous ſpirits, the vegetables called narcotic, the vegetable animal and mineral ſubſtances called antiſpaſmodies, affect our ſpirits and ſenſes; and why is the moſt inflammable or phlogiſtic part of all theſe, when ſeparated from the other parts, the moſt powerful narcotic or antiſpaſmodic or exhilerant?

Why doth the electrical fluid give us ſe of cold, on the coaſt where it is excited.

Why doth air, of a certain temperatu according to the thermometer, give us ſen of cold, much greater, than is given by a of the like temperature, according to the ther mometer, in other conditions of the atmoſ phere. Or in other words; what is th cauſe, that we are chilled by air, which th thermometer denoteth not to be ſo cold a air otherwiſe conditioned, in which we ar not chilled.

Apology for the imperfections and error of this Syllabus, and the improvident uſe o poſitive expreſſions in dubious doctrines.

FINIS.